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JUN 21 1999

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

June 21, 1999

BY HAND DELIVERY

Magalie Salas, Esquire
Secretary
Federal Communications Commission
445 12th Street SW, Room TW-B204
Washington DC 20554

Re: Amendment of Part 18 of the Commission's Rules to Update Regulations for RF Lighting Devices, ET Docket No. 98-42 — *Ex Parte* Communication

Dear Ms. Salas:

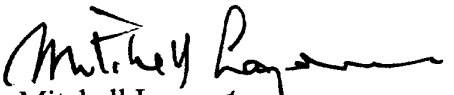
Pursuant to Section 1.1206(b)(1) of the Commission's Rules, I enclose two copies of correspondence for inclusion in the above-referenced docket.

Kindly date-stamp and return the extra copy of this letter.

No. of Copies rec'd 0+2
List A B C D E

If there are any questions about this filing, please call me at the number above.

Respectfully submitted,



Mitchell Lazarus
Counsel for Harris Corporation,
Symbol Technologies, Inc., and
3Com Corporation.

cc: David Jatlow, Esquire, Counsel for Bluetooth Promoters
Ray Martino, Symbol Technologies, Inc.
Carlos Rios, 3Com Corporation
Steve Sharkey, AirTouch Communications, Inc.
Larry Solomon, Esquire, Counsel for Metricom, Inc.,
William D. Wallace, Esquire, Counsel for Globalstar, L.P.
Jim Zyren, Harris Corporation
Terry Mahn, Esquire, Counsel for Fusion Lighting
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June 21, 1999

BY TELECOPIER AND FIRST CLASS MAIL

Terry G. Mahn, Esquire
Fish & Richardson P.C.
601 Thirteenth Street, NW
Washington, DC 20005

Dear Terry:

Thank you for your detailed response of May 19 (as amended on May 28) to the second proposal by the Part 15/MSS interests.

Based on the data you and your client provided, the Part 15 interests have prepared a third proposal, which is attached. We believe this proposal is generally consistent with the successful operation of RF lighting equipment, as described in your May 28 presentation, while still enabling Part 15 devices to communicate, albeit with some degree of impairment.

This proposal is intended as a compromise, and as such entails a degree of sacrifice from each of the parties. The brunt of the impact is taken by Part 15 systems — especially direct sequence spread spectrum systems, which stand to lose a full third of their capacity. Frequency hopping spread spectrum systems will likewise be affected. We acknowledge there may also be cost implications for RF lighting equipment, but we believe these should be minor, especially as production volumes increase.

In addition to offering our technical proposal, I must respond to the legal issues raised in your May 19 letter. I refer particularly to the passage that states it is illegal to certify and market Part 15 products, on the ground that these products create "spectrum conflicts for senior authorized [ISM] users." You assert that giving customers a choice between Part 15 and ISM products is unlawful because ISM products have precedence in the band.

This novel view misapprehends the relationship between Part 15 and ISM. Section 15.5(b) states the priorities very clearly: Part 15 must accept interference caused by lawfully operating ISM equipment. (No rule is needed for the reverse direction because ISM equipment, having no receiver function, is not susceptible to incoming interference, and so cannot be affected by Part 15 operation.) Having given ISM priority in the band, the Commission has no obligation to protect the market for ISM equipment by outlawing other products that users

might find more useful. If you care to spell out the legal and constitutional principles you believe compel a contrary result, we will be glad to respond on the merits.

In any event, we believe the attached proposal shows that Part 15 and ISM can successfully coexist in the band, assuming the parties are willing to make some adjustments to accommodate one another. Fusion's endorsement of this proposal would enable customers to enjoy the benefits of both RF lighting technology and, if they wish, 2.4 GHz Part 15 spread spectrum as well, and so stands to increase markets for all of the affected industries.

I am authorized to state that the following entities support the attached proposal:

3Com Corporation
Harris Corporation
Metricom, Inc.
Symbol Technologies, Inc.

My colleagues and I look forward to the scheduled meeting in your office at 9 am on Friday, June 25. Please call if you have any questions in the meantime on the enclosed proposal.

Sincerely,

Mitchell Lazarus
Counsel for Harris Corporation,
Symbol Technologies, Inc., and
3Com Corporation.

ML:deb

cc: Office of the Secretary, FCC (two copies)
David Jatlow, Esquire, Counsel for Bluetooth Promoters
Ray Martino, Symbol Technologies, Inc.
Carlos Rios, 3Com Corporation
Steve Sharkey, AirTouch Communications, Inc.
Larry Solomon, Esquire, Counsel for Metricom, Inc.,
William D. Wallace, Esquire, Counsel for Globalstar, L.P.
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Third Proposal to Fusion Lighting

1.0 Regulatory Background

RF Lighting devices are authorized as Part 18 devices, but present FCC Rules make no allowance for operation at frequencies above 1 GHz. Part 18 devices currently have no FCC limit on RF emissions within the ISM bands, other than the RF safety limits discussed below. Part 15 and other equipment operating in the ISM bands generally must accept interference generated by equipment authorized under Part 18.

All RF-emitting devices, including microwave ovens and RF lighting equipment, are subject to regulations pertaining to human exposure. These regulations limit general population exposure above 1500 MHz to 1 mW/cm^2. Measurements are normally taken at a distance of 20 cm from the device. OET Bulletin 65 at 50, *citing* ANSI C95.3. Though it is far from rigorous to model a microwave oven or an RF light as a point source at a range of only 20 cm, a rough estimate of the de facto limit on in-band emissions for unrestricted devices can be derived:

Exposure limit = 1 mW / cm^2

Area of sphere with 20 cm radius = $4 \pi r^2$ = 5026 cm^2

Max allowable EIRP = 1 mW / cm^2 x 5026 cm^2 = 5026 mW = 5 Watts

Although the regulations limit human exposure, they place no limit on RF emissions per se. A device can emit much more than 5 W if it is not accessible during normal operation. For example, if an RF lighting device were mounted on a tower to provide lighting for a roadway, parking lot, or stadium, so that no member of the public could approach within some arbitrary distance of the device, the allowable level of in-band RF emission would be considerably higher. Consider the following example:

A lighting device is mounted on a 12 meter mast to provide stadium lighting. The tower is equipped with a ladder for service access, but access to the ladder is physically barred by means of a locked gate. It is estimated that a member of the public cannot come any closer than 10 meters from the RF light during normal operation. The limit on exposure to the general public of 1 mW/cm^2 is still in effect, but due to the greater distance from the device at which the limit is applied, the allowable EIRP is much greater:

Exposure limit = 1 mW / cm^2

Area of sphere with 10 m radius = $4 \pi r^2$ = 1.26 x 10^7 cm^2

Max Allowable EIRP = 12.6 KW

This value seems high at first glance, but it should be kept in mind that RF lighting devices are commonly equipped with magnetron sources which are rated at 1.4 KW, and have been built with magnetrons rated up to 5 KW. These devices are typically shielded to comply with the general population limit, but in some applications, there is no regulatory requirement for even this measure. In addition, it is impossible to predict what the effects of future developments of this technology may have on in-band RF emissions.

Under present rules, these safety limits are the only constraint on in-band ISM emissions.

(The Part 15/MSS parties do not allege that RF lights operate at unsafe levels. To the contrary, these calculations show that RF lights can operate at relatively high EIRPs while still remaining within RF safety limits.)

A few RF lighting devices located in an outdoor application would impair the reliability of nearby Bluetooth and WLAN devices, and would also jeopardize point-to-point links and MSS downlinks for a considerable distance. We have to assume that RF lighting manufacturers seek to make this technology ubiquitous. In addition, RF lighting devices are being developed at lower power levels (50 Watts) for indoor applications.

2.0 History of Part 15/MSS-Fusion Negotiations

The Part 15/MSS Interests have made two proposals to Fusion Lighting. Both were rejected.

The first proposal, in January 1999, called for a peak emission limit of 20 mV per meter across the entire 2.400 - 2.500 GHz ISM band, as shown in Figure 2.0-1.

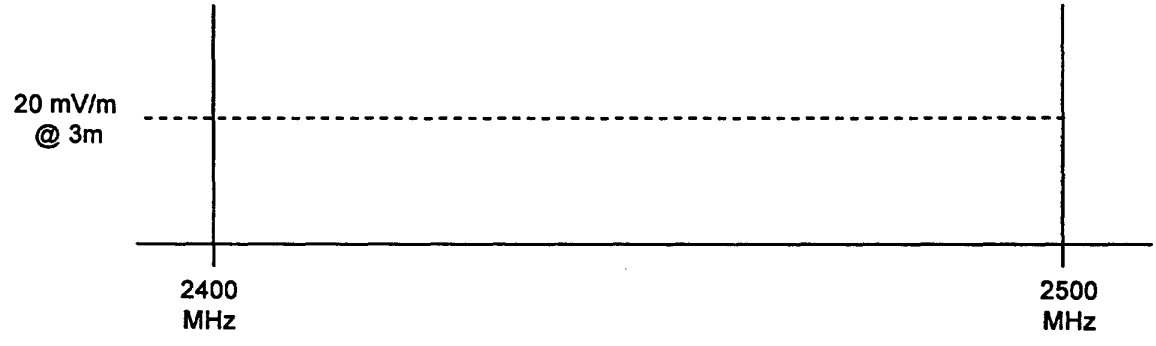
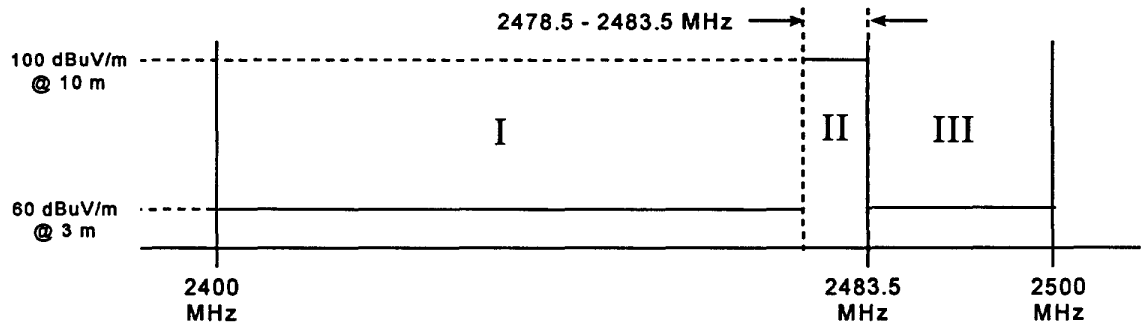


Figure 2.0-1 Initial Part 15/MSS proposal for In-band Emission limit for RF Lights (Jan '99)

Fusion Lighting rejected this proposal, asserting that the limit was too low to accommodate its technology.

The Part 15/MSS interests presented an alternative proposal in March. Its salient feature was a 5 MHz wide band from 2.4785 GHz to 2.4835 GHz within which the CISPR limit on RF lighting would apply. The remainder of the 2.4000 to 2.5000 GHz ISM band would have a limit of 1 mV/m @ 3m as shown in Figure 2.0-2.



Region I : 2400 - 2478.5 MHz. RF lighting restricted to Part 15, Class A limit.

Region II : 2478.5 - 2483.5 MHz. RF Light emission limit of 100 dBuV/m @ 10 m (equivalent to 330 mVm @ 3m). Consistent with CISPR15 limits.

Region III : 2483.5 - 2500 MHz. RF lighting restricted to Part 15, Class A limit. This portion of the band includes satellite services.

Figure 2.0-2 Second Part 15/MSS Proposal for In-Band Emission Limit for RF Lights (Mar '99)

The CISPR limit of 100 dBuV/m @ 10 meters is the in-band limit on emissions from RF lighting devices in Europe. This is an average limit. It translates to an average field strength of 330 mV/m @ 3m. While this is relatively high, it does place a restriction on in-band emission.

Fusion Lighting rejected this proposal as well.

2.1 Implications of Second Proposal

The 5 MHz band for higher emissions as described in the second proposal would have had two significant consequences for Fusion Lighting.

First, it would require the use of DC power supplies. Most consumer microwave ovens and RF lights currently use half wave rectified power supplies to minimize cost. However, the voltage transients which occur on every cycle of the 60 Hz AC power sine wave cause the magnetrons in these devices to sweep in frequency over a large portion of the ISM band, as shown in Figure 2.1-1.

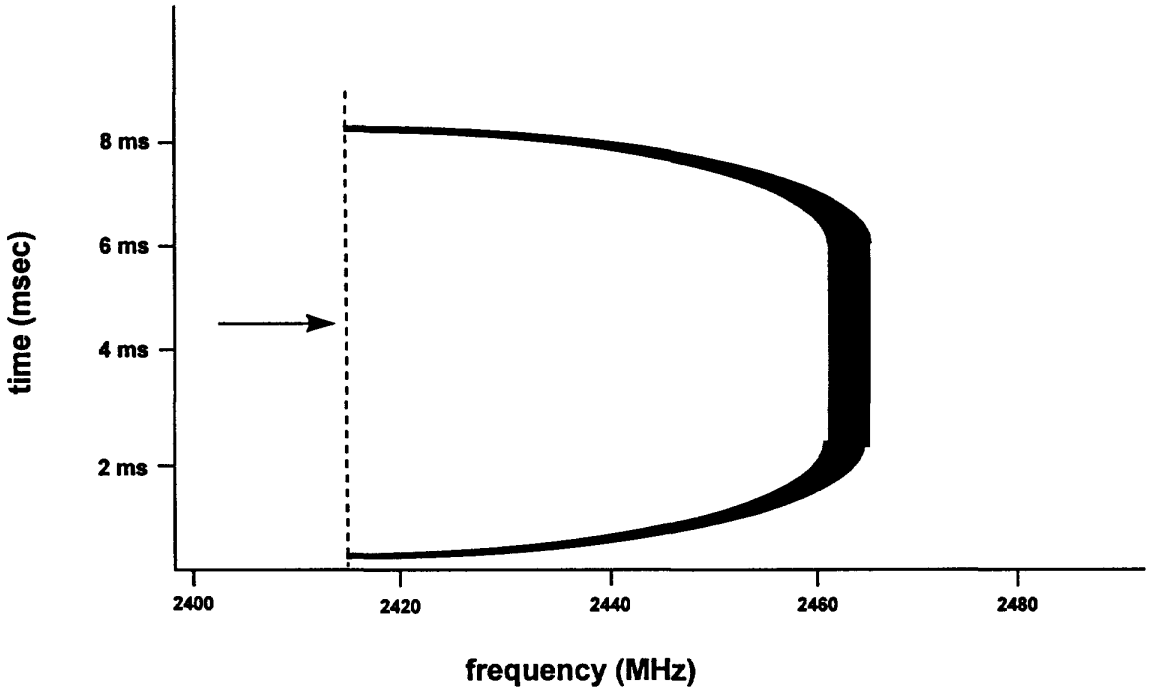


Figure 2.1-1 Magnetrons Sweep in Frequency Due to Power Supply Voltage Transients

As a result of using half wave rectification, the duty cycle of the magnetron is 50%. This allows some transmission of data between bursts of microwave interference. The latest data submitted by Fusion Lighting indicates they are now evaluating full wave rectified power supplies and switching DC supplies. The resulting voltage generated by half-wave, full-wave, and switching DC supplies are shown in Figures 2.1-2, 2.1-3, and 2.1-4.

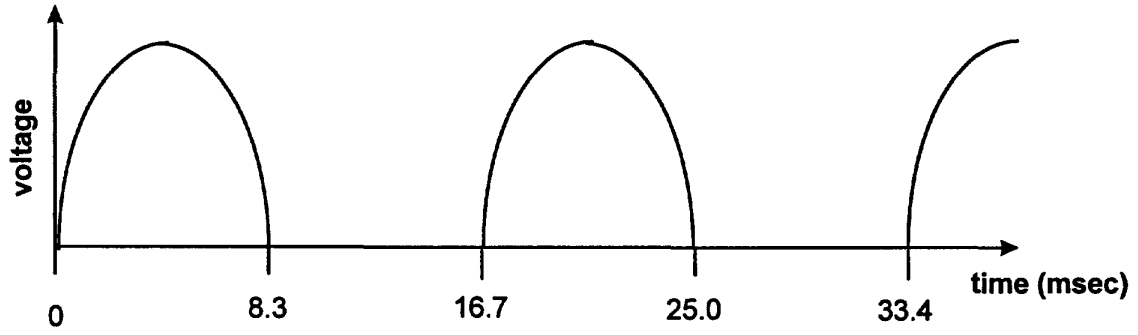


Figure 2.1-2 Voltage Output of Half-Wave Rectified Power Supply

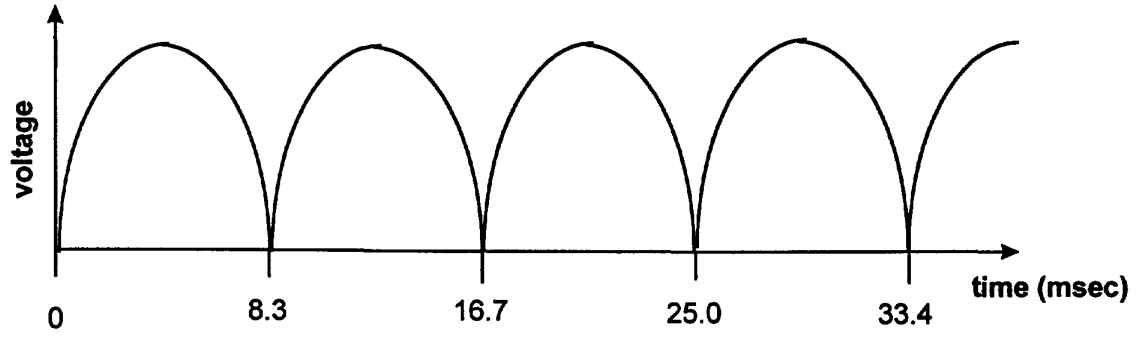


Figure 2.1-3 Voltage Output of Full-Wave Rectified Power Supply

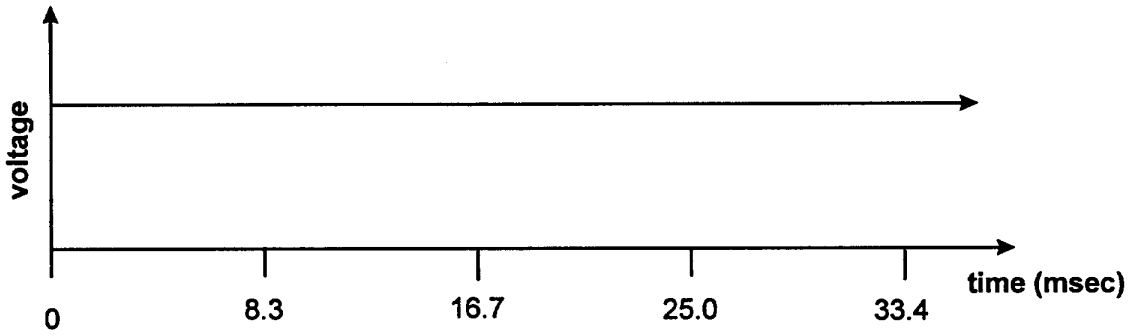


Figure 2.1-4 Voltage Output of Switching DC Power Supply

The use of full wave rectified power supplies with no ripple suppression represents a "worst case" from a communications point of view. The voltage transients are still present, so the magnetron would still sweep over the ISM band, but the duty cycle would essentially be 100%. Even if half wave rectified supplies are used, there could be no guarantee that installations of multiple lights would have all devices on the same phase of the power cycle. It is quite possible that the lighting load would be distributed among all three phases of AC power, resulting in continuous interference.

By using switching DC supplies, the magnetron frequency can be stabilized. Magnetrons are inherently narrowband devices. In the absence of voltage transients, they can all be located in some relatively narrow portion of the ISM band.

The other effect of the 5 MHz band for higher emissions in the second Part 15/MSS proposal would be the need to shift the magnetron center frequency to about 2481 MHz. This minimizes overlap with the frequencies used by Part 15 frequency-hopping and direct sequence spread spectrum radios. It also keeps high power emissions out of the MSS band (2483.5 MHz to 2500 MHz).

3.0 Fusion Data

Fusion provided a formal response to the Part 15/MSS proposals on May 17, with a minor revision on May 28. (References here are to the May 28 version.) Although Fusion's response to the Part 15/MSS proposals was generally negative, Fusion provided some useful data on emissions from RF lights. Those data lead to the third proposal set out below.

Figure 4 of the Fusion response shows the effect of using a switching DC power supply. RF emissions are contained within a relatively narrow bandwidth. In addition, this data indicates that the Fusion lighting devices have an average RF emission level of 195 mV/m. This is well within the 330 mV/m proposed in the Part 15/MSS second proposal.

The main problem appearing in Fusion's data, from the Part 15 standpoint, is a frequency of operation centered at about 2450 MHz. This is well outside the 2478.5 MHz - 2483.5 MHz region in the Part 15/MSS second proposal. Nevertheless, Fusion's data demonstrate that the use of DC power can stabilize magnetron center frequency. In addition, the data showed that the CISPR limit of 330 mV/m @ 3m is a practical limit which the RF lighting interests could adhere to. Figure 4 of the Fusion response also indicates that limit of 1 mV/m average field strength elsewhere in the band is attainable.

The other significant issue in Fusion's data is that of frequency drift. Page 9 of the Fusion response states that frequency drift of the magnetron due to aging is typically 3 to 4 MHz.

4.0 Third Proposal

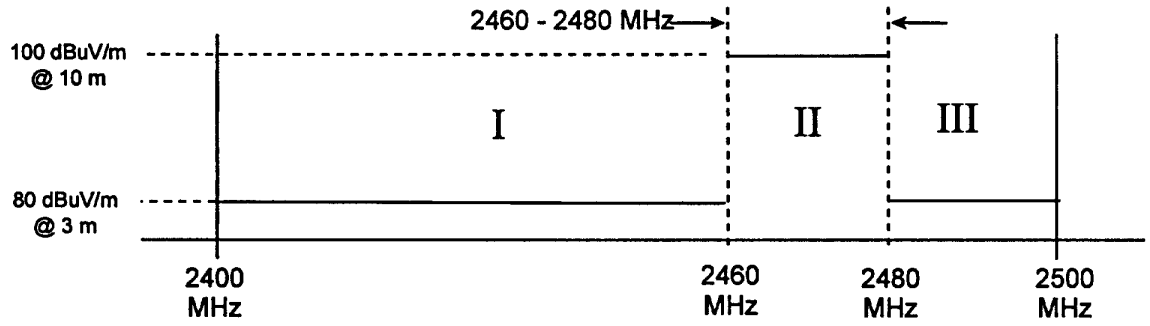
Several conclusions can be drawn from data Fusion has provided:

1. The use of DC power supplies can effectively contain emissions from RF lights to a relatively narrow bandwidth.

2. The CIPSR limit on in-band emissions, which offers a measure of protection to Part 15 receivers, is achievable in RF lighting equipment.

3. In-band emissions that are removed from the resonant frequency of the magnetron are typically below 2 mV/m (average).

This third proposal is a serious attempt to balance both the concerns of the Part 15 Interests and those of Fusion Lighting (as reflected in Fusion's May 28 response). We propose to widen the region of higher emissions to 20 MHz, to be located at 2460 to 2480 MHz. The greater bandwidth over which the CISPR limit applies is intended to provide a reasonable frequency tolerance for the magnetrons and to accommodate a drift of ±4 MHz due to aging, as indicated in the Fusion data. In addition, the limit on emissions elsewhere in the band from is increased to 10 mV/m at 3m (average). The modified PSD is shown in Figure 4.0-1.



Region I : 2400 - 2460 MHz. RF lighting restricted to 10 mV/m (avg)

Region II: 2460 - 2480 MHz. RF Light emission limit of 100 dBuV/m @ 10 m (equivalent to 330 mVm @ 3m). Consistent with CISPR15 limits.

Region III: 2480 - 2500 MHz. RF lighting restricted to 10 mV/m (avg)
This portion of the band includes MSS satellite services.

Figure 4.0-1 Modified PSD for In-band Emission from RF Lights

4.1 Impact on RF Lighting

The Part 15 interests acknowledge the modified proposal described in Section 4.0 may have some cost implications for Fusion Lighting, but we expect these should not be prohibitive. First, the center frequency of the magnetrons must be shifted to 2470 MHz. (A center frequency near 2450 MHz, as presently implemented, would disrupt two of the three direct sequence channels, while a center frequency of 2470 MHz threatens only one. Shifting the center frequency to 2470 MHz thus effectively doubles throughput in direct sequence systems.) The incremental cost of shifting the center frequency can be

expected to decline as production volumes increase. Second, the proposal effectively requires the use of DC power supplies to drive the magnetrons, although significant ripple on the DC power could be accepted without causing drift in operating frequency of the magnetron. Published data [1] suggests that DC ripple could be on the order of 3 to 5 dB. DC power supplies should therefore be economically feasible.

4.2 Impact on Part 15 Interests

This proposal also entails potentially significant adverse effects for the Part 15 Interests. The operation of RF lights between 2460 MHz to 2480 MHz threatens interference to direct sequence Channel 11, but protects Channels 1 and 6. In short, direct sequence spread spectrum systems would sacrifice channel in RF lighting environments in exchange for protection of two others.

While the proposed band of higher emission is 20 MHz wide, the actual operating bandwidth of an individual RF light should be less than 1 MHz. Unless several lighting devices were located close together and operating at markedly different parts of the 20 MHz high-emissions band, the impact on frequency hopping systems should be acceptable.

References

1. J. Horne, S. Vasudevan, "Modeling and Mitigation of Interference in the 2.4 GHz ISM Band", Applied Microwaves & Wireless, March/April 1997, pp. 59-71.

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